CLAIMS

1. A method of inducing the formation or repair of blood vessels in a target tissue of a patient, the method comprising the step of administering to said patient an effective amount of a population of enriched perivascular mesenchymal precursor cells (MPCs) to induce new blood vessel formation in target tissue.

2. The method of formation or repair of blood vessels of claim 1 wherein the MPCs are positive for the marker 3G5.

3. The method of formation or repair of blood vessels of claim 1 wherein the MPCs are positive for the marker STRO-1.

4. The method of formation or repair of blood vessels of claim 1 wherein the MPCs are positive for the markers MUC18/CD146 and alpha-smooth muscle actin.

5. The method of formation or repair of blood vessels of claim 2 wherein the MPCs additionally coexpress the marker STRO-1.

6. The method of formation or repair of blood vessels of claim 2 or 3 wherein the MPCs additionally coexpress the marker MUC18/CD146.

7. The method of formation or repair of blood vessels of claim 3 wherein the MPCs additionally co-express the marker VCAM-1.

8. The method of formation or repair of blood vessels of claim 1 wherein the MPCs co-express MUC18/CD146, alpha-smooth muscle actin, STRO-1, and 3G5.

9. The method of formation or repair of blood vessels of claim 2 or 3 wherein the MPCs co-express any one or more of the markers selected from the group consisting of THY-1, VCAM-1, ICAM-1, PECAM-1, CD49a/CD49b/CD29, CD49c/CD29, CD49d/CD29, CD29, CD61, integrin beta5, 6-19, thrombomodulin, CD10, CD13, SCF, PDGF-R, EGF-R, IGF-1R, NGF-R, FGF-R, Leptin-R (STRO-2).

10. The method of formation or repair of blood vessels of claim 1 wherein the MPCs are negative for the markers CD34, CD45, and glycophorin-A.

11. The method of formation or repair of blood vessels of claim 1, the enriched population of MPCs comprising at least 0.01% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

12. The method of formation or repair of blood vessels of claim 1, the enriched population of MPC comprising at least 0.1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

13. The method of formation or repair of blood vessels of claim 1, the enriched population of MPC comprising at least 1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

14. The method of formation or repair of blood vessels of claim 1, the enriched population of MPC comprising at least 0.01% STRO-1bright MPCs.

15. The method of formation or repair of blood vessels of claim 1, the enriched population of MPC comprising at least 0.1% STRO-1bright MPCs.

16. The method of formation or repair of blood vessels of claim 1, the enriched population of MPC comprising at least 1% STRO-1bright MPCs.

17. The method of formation or repair of blood vessels of any one of claims 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10 wherein the population is enriched from a tissue of the group comprising, but not limited to, adipose tissue, teeth, dental pulp, skin, liver, kidney, heart, retina, brain, hair follicles, intestine, lung, spleen, lymph node, thymus, pancreas, bone, ligament, bone marrow, tendon, and skeletal muscle.

18. The method of formation or repair of blood vessels of claims 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10 wherein the enriched population is expanded prior to administration.

19. The method of formation or repair of blood vessels of claim 18 wherein the expanded population comprises at least 0.01% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

20. The method of formation or repair of blood vessels of claim 18 wherein the expanded population comprises at least 0.1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

21. The method of formation or repair of blood vessels of claim 18 wherein the expanded population comprises at least 1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

22. The method of formation or repair of blood vessels of claim 18 wherein the expanded population comprises at least 0.1% STRO-1bright MPCs.

23. The method of formation or repair of blood vessels of claim 18 wherein the expanded population comprises at least 1% STRO-1bright MPCs.

24. The method of formation or repair of blood vessels of claim 18 wherein the expanded population comprises at least 10% STRO-1bright MPCs.

25. The method of formation or repair of blood vessels of claim 18 wherein the cell population are expanded in the range of between 102 to 104 fold.

26. The method of formation or repair of blood vessels of claim 1 wherein the population of cells is adminstered by injection into the target tissue or close to the target tissue.

27. The method of formation or repair of blood vessels of claim 1 wherein the population of cells is administered systemically

28. The method of formation or repair of blood vessels of claim 1 wherein the population of cells is administered topically.

29. The method of formation or repair of blood vessels of claim 1 wherein at least about 105 MPC are administered.

30. The method of formation or repair of blood vessels of claim 1 wherein at least about 106 MPC are administered.

31. The method of formation or repair of blood vessels of claim 1 wherein at least about 107 MPC are administered.

32. The method of formation or repair of blood vessels of claim 1 including the coadministration of a substance to enhance formation of blood vessels.

33. The method of formation or repair of blood vessels of claim 1 wherein the target tissue exhibits ischemia

34. The method of formation or repair of blood vessels of claim 1 wherein said patient is in need of treatment for a condition selected from the group consisting of cerebrovascular ischemia, renal ischemia, pulmonary ischemia, limb ischemia, ischemic cardiomyopathy and myocardial ischemia.

35. The method of formation or repair of blood vessels of claim 1 wherein the patient is a non-human mammal.

36. The method of formation or repair of blood vessels of claim 1 wherein the patient is human.

37. The method of formation or repair of blood vessels of claim 1 wherein the MPC is modified to express an exogenous gene.

38. The method of formation or repair of blood vessels of claim 1 including the coadministration of hematopoietic bone marrow cells.

39. The method of formation or repair of blood vessels of claim 1 including the coadministration of endothelial precursors cells.

40. A vascular graft formed by the method of claim 1.

41. A method of repairing damaged tissue in a human subject in need of such repair, the method comprising:

(a) obtaining an enriched population of MPC, and

(b) contacting an effective amount of the enriched population of MPC with the damaged tissue of said subject

42. A method of repairing damaged tissue in a human subject in need of such repair, the method comprising:

(a) expanding the enriched MPC of claim 41 in culture, and

(b) contacting an effective amount of the expanded cells with the damaged tissue of said subject.

43. The method of claim 41 or 42 wherein the damaged tissue is myocardium.

44. The method of claim 41 or 42 wherein the damaged tissue is myocardium and the said subject suffers from a cardiovascular disease comprising, but not limited to, ischemic heart disease, coronary artery disease, acute myocardial infarction, congestive heart failure, cardiomyopathy, or angina.

45. The method of claim 43 or 44 wherein an effective amount of the enriched MPC is administered to thereby treat the cardiovascular disease.

46. The method of claim 43 or 44 wherein the cells are introduced into the body of the subject by localized injection, systemic injection, in a patch, or on a stent.

47. The method of claim 43 or 44 wherein the effective amount of the enriched population of MPC is administered by intracoronary catheter, or by intramyocardial, trans-epicardial or transendocardial injection.

48. The method of claim 43 or 44 wherein contacting the enriched population of MPC with myocardium results in improved cardiac function.

49. The method of claim 43 or 44 wherein contacting the enriched population of MPC with myocardium results in reduced numbers of apoptotic cardiomyocytes and/or in increased numbers of regenerating cardiomyocytes.

50. The method of claim 1, 43 or 44 wherein contacting the enriched population of MPC with myocardium results in increased numbers of blood vessels, arterioles, capillaries and venules.

51. The method of claim 1, 43 or 44 wherein the enriched population of MPC secrete paracrine factors which result in angiogenesis, vasculogenesis, myogenesis or arteriogenesis.

52. The method of claim 1, 43 or 44 wherein the enriched population of MPC assemble into new blood vessel structures.

53. The method of claim 43 or 44 wherein the enriched population of MPC differentiate and assemble into cardiomyocytes.

54. A method of using the MPC as in claims 1, 43 or 44 wherein the cells are autologous.

55. A method of using the MPC as in claims 1, 43 or 44 wherein the cells are from an allogeneic source.

56. The method of claim 41, 42 or 43 wherein the MPCs are positive for the marker 3G5.

57. The method of claim 41, 42 or 43 wherein the MPCs are positive for the marker STRO-1.

58. The method of claim 41, 42 or 43 wherein the MPCs are positive for the markers MUC18/CD146 and alpha-smooth muscle actin.

59. The method of claim 56 wherein the MPCs additionally coexpress the marker STRO-1.

60. The method of of claim 56 or 57 wherein the MPCs additionally coexpress the marker MUC18/CD146.

61. The method of 57 wherein the MPCs additionally co-express the marker VCAM-1.

62. The method of claim 41, 42 or 43 wherein the MPCs co-express MUC18/CD146, alpha-smooth muscle actin, STRO-1, and 3G5.

63. The method of claim 56, 57 or 58 wherein the MPCs co-express any one or more of the markers selected from the group consisting of THY-1, VCAM-1, ICAM-1, PECAM-1, CD49a/CD49b/CD29, CD49c/CD29, CD49d/CD29, CD29, CD61, integrin beta5, 6-19, thrombomodulin, CD10, CD13, SCF, PDGF-R, EGF-R, IGF-1R, NGF-R, FGF-R, Leptin-R (STRO-2).

64. The method of claim 41, 42 or 43 wherein the MPCs are negative for the markers CD34, CD45, and glycophorin-A.

65. The method of claim 41, 42 or 43 comprising at least 0.01% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

66. The method of claim 41, 42 or 43 comprising at least 0.1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

67. The method of claim 41, 42 or 43 comprising at least 1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

68. The method of claim 41, 42 or 43 comprising at least 0.01% STRO-1bright MPCs.

69. The method of claim 41, 42 or 43 comprising at least 0.1% STRO-1bright MPCs.

70. The method of claim 41, 42 or 43 comprising at least 1% STRO-1bright MPCs.

71. The method of any one of claims 56, 57, 58, 59, 60, 61, 62, 63 or 64 wherein the population is enriched from a tissue of the group comprising, but not limited to, adipose tissue, teeth, dental pulp, skin, liver, kidney, heart, retina, brain, hair follicles, intestine, lung, spleen, lymph node, thymus, pancreas, bone, ligament, bone marrow, tendon, and skeletal muscle.

72. The method of claims 56, 57, 58, 59, 60, 61, 62, 63 or 64 wherein the enriched population is expanded.

73. The method of claim 72 wherein the expanded population comprises at least 0.01% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

74. The method of claim 72 wherein the expanded population comprises at least 0.1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

75. The method of claim 72 wherein the expanded population comprises at least 1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

76. The method of claim 72 wherein the expanded population comprises at least 0.1% STRO-1bright MPCs.

77. The method of claim 72 wherein the expanded population comprises at least 1% STRO-1bright MPCs.

78. The method of claim 72 wherein the expanded population comprises at least 10% STRO-1bright MPCs.

79. A method of inducing formation or repair of blood vessels, the method comprising the steps of providing a population of enriched perivascular mesenchymal precursor cells (MPCs), contacting said cells with a growth media, and culturing said cells under conditions to induce them to differentiate into new blood vessels.

80. The method of formation or repair of blood vessels of claim 79 wherein the MPCs are postive for the marker 3G5.

81. The method of formation or repair of blood vessels of claim 79 wherein the MPCs are postive for the markers MUC18/CD146 and alpha-smooth muscle actin.

82. The method of formation or repair of blood vessels of claim 79 wherein the MPCs are postive for the markers STRO-1.

83. The method of formation or repair of blood vessels of claim 79 wherein the MPCs additionally coexpress the the marker STRO-1.

84. The method of formation or repair of blood vessels of claim 79 wherein the MPCs additionally coexpress the marker MUC18/CD146.

85. The method of formation or repair of blood vessels of claim 79 wherein the MPCs additionally co-express the marker VCAM-1.

86. The method of formation or repair of blood vessels of claim 79 wherein the MPCs co-express MUC18/CD146, alpha-smooth muscle actin, STRO-1, and 3G5.

87. The method of formation or repair of blood vessels of claim 78 wherein the MPCs are negative for the markers CD34, CD45, and glycophorin-9.

88. The method of formation or repair of blood vessels of any one of claims 80, 81, 82, 83, 84, 85, 86 or 87 wherein the population is enriched from a tissue of the group comprising, but not limited to, adipose tissue, teeth, dental pulp, skin, liver, kidney, heart, retina, brain, hair follicles, intestine, bone marrow, lung, spleen, lymph node, thymus and pancreas.

89. A vascular graft formed by the method of claim 79.

90. A composition for use in inducing heart vessel formation comprising a population of mesenchymal precursor cells (MCPs) in a pharmaceuticaly acceptable carrier, said MPCs carrying a perivascular marker and being a vascular progenitor.

91. A composition of claim 90 wherein the MPCs are positive for the marker 3G5.

92. A composition of claim 90 wherein the MPCs are positive for the marker STRO-1.

93. A composition of claim 90 wherein the MPCs are postive for the markers MUC18/CD146 and alpha-smooth muscle actin.

94. A composition of claim 91 wherein the MPCs additionally coexpress the marker STRO-1.

95. A composition of claim 91 wherein the MPCs additionally coexpress the marker the marker MUC18/CD146.

96. A composition of claim 92 wherein the MPCs additionally co-express the marker VCAM-1.

97. A composition of claim 90 wherein the MPCs co-express MUC18/CD146, alpha-smooth muscle actin, STRO-1, and 3G5.

98. A composition of claim 91 or 92 wherein the MPC co-expresses a marker selected from, but not limited to, the group comprising, THY-1, VCAM-1, ICAM-1, PECAM-1, CD49a/CD49b/CD29, CD49c/CD29, CD49d/CD29, CD29, , CD61, integrin beta5, 6-19, thrombomodulin, CD10, CD13, SCF, PDGF-R, EGF-R, IGF-1R, NGF-R, FGF-R, Leptin-R (STRO-2).

99. A composition of claim 90 wherein the MPCs are negative for the markers CD34, CD45, and glycophorin-A.

100. A composition of claim 90 comprising at least 0.01% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

101. A composition of claim 90 comprising at least 0.1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

102. A composition of claim 90 comprising at least 1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

103. A composition of claim 90 comprising at least 0.01% STRO-1bright MPCs.

104. A composition of claim 90 comprising at least 0.1% STRO-1bright MPCs.

105. A composition of claim 90 comprising at least 1% STRO-1bright MPCs.

106. A composition of any one of claims 91, 92, 93, 94, 95, 96, 97, 98 or 99 wherein the population is enriched from a tissue of the group comprising, but not limited to, adipose tissue, teeth, dental pulp, skin, liver, kidney, heart, retina, brain, hair follicles, intestine, bone marrow, lung, spleen, lymph node, thymus and pancreas.

107. A composition of any one of claims 91, 92, 93, 94, 95, 96, 97, 98 or 99 wherein the enriched population is expanded.

108. A composition of claim 107 wherein the expanded population comprises at least 0.01% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

109. A composition of claim 107 wherein the expanded population comprises at least 0.1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

110. A composition of claim 107 wherein the expanded population comprises at least 1% MPCs capable of forming a clonogenic colony and differentiating to three or more mesenchymal tissue types.

111. A composition of claim 107 wherein the expanded population comprises at least 0.1% STRO-1bright MPCs.

112. A composition of claim 107 wherein the expanded population comprises at least 1% STRO-1bright MPCs.

113. A composition of claim 107 wherein the expanded population comprises at least 10% STRO-1bright MPCs.

114. A composition of claims 90 or 107 wherein the cells are autologous.

115. A composition of claims 90 or 107 wherein the cells are from an allogeneic source.

116. A composition of claims 90 or 107 wherein the cell population are expanded from between 102 to 104 fold.

117. The composition of claim 90 or 107 said composition being adminstered by injection into the target tissue or close to the target tissue.

118. The composition of claim 90 or 107 wherein at least about 105 MPC are administered.

119. The composition of claim 90 or 107 wherein at least about 106 MPC are administered.

120. The composition of claim 90 or 107 wherein at least about 107 MPC are administered.

121. The composition of claim 90 or 107 wherein a substance to enhance formation of blood vessels is coadministered.

122. The composition of claim 90 or 107 wherein the target tissue exhibits ischemia.

123. The composition of claim 90 or 107 wherein said patient is in need of treatment for cerebrovascular ischemia, renal ischemia, pulmonary ischemia, limb ischemia, ischemic cardiomyopathy and myocardial ischemia.

124. The composition of claim 90 or 107 wherein the patient is a non-human mammal.

125. The composition of claim 90 or 107 wherein the patient is human.

126. The composition of claim 90 or 107 wherein the MPC is modified to express an exogenous gene.

127. The composition of claim 90 or 107 wherein the composition is coadministered with hematopoietic bone marrow or endothelial precursors cells.

128. The composition of claim 90 or 107 wherein the enriched population is substantially free of hematopoietic precursor cells and endothelial precursor cells.

129. The composition of claim 90 or 107 additionally comprising one or more blood vessel promoting compounds.

130. The composition of claim 129 wherein the blood vessel promoting compounds are one or more selected from the group consisting of acidic and basic fibroblast growth factors, vascular

endothelial growth factor, epidermal growth factor, transforming growth factor α and β, platelet-derived endothelial growth factor, platelet-derived growth factor, tumor necrosis factor alpha, hepatocyte growth factor, insulin like growth factor, erythropoietin, colony stimulating factor, macrophage-CSF, granulocyte/macrophage CSF and nitric oxidesynthase.